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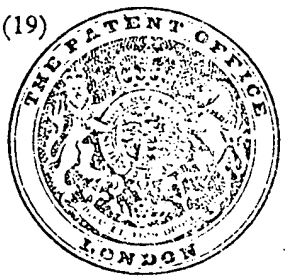

(54) CONVECTOR SPACE HEATING OR COOLING APPARATUS

(71) I, DEREK MILES, a British subject, of Colespond Farm, West Tytherley, Near Salisbury, Wiltshire, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to convector space heating or cooling apparatus.

According to the invention, a convector space heating or cooling apparatus comprises a pair of sheet members of heat conducting material secured together to form a duct through which a heating or cooling liquid can flow, at least a front one of the sheet members being so shaped as to give it a greater wall length than the length of the radiator and to form, with a plate secured thereto, a plurality of channels, between said front one of the sheet members and the plate, for the passage of air, and a front panel so disposed and arranged with respect to said plate and the walls of the duct that in operation transfer of heat from the walls of the duct to the front panel is limited, whereby the front panel, when the apparatus is used for heating, can only attain a temperature significantly lower than the temperature of the walls of the duct.

Advantageously both of the sheet members are so shaped and a respective plate is provided for each of the sheet members, that is to say the apparatus includes a front plate and a rear plate. Each of the shaped sheet members may be formed to a zig-zag and the two sheet members may extend in parallel to one another and spaced apart to form a zig-zag duct of flattened cross-section.

Alternatively the shaped sheet members may each lie generally in a respective vertical plane, with the two planes being spaced apart one from the other and with portions of the shaped sheet members drawn out laterally from their respective planes, at intervals along the length of the apparatus, to form lateral extensions of the duct defined by the portions of the sheet members lying in said respective vertical planes.

The channels, when the apparatus is installed, are preferably substantially vertical. Apertures may be provided in, or mounting brackets on, the rear plate whereby the apparatus may be supported from a wall.

The front and/or rear plate may be louvred to allow passage of air therethrough.

The duct and the front and rear plates are advantageously formed from a metal, preferably mild steel sheet. If preferred, however, the duct may be formed of a non-metallic material, for example glass reinforced plastics material, to obviate problems of corrosion.

In operation, heated circulating water in a closed circuit passes through an inlet valve into the apparatus and passes out through an outlet valve. Heat from the water passing through the apparatus is conducted through the walls of the duct to be carried away by convection by air passing through the channels defined by the duct and the front and rear plates and also passes by conduction to the front and rear plates to be carried away by convection air currents passing over the front and rear plates.

Apparatus according to the invention is particularly though not exclusively applicable to high temperature central heating systems, such high water temperatures making possible an increased heat emission for a determined size of apparatus compared with a conventional radiator. Although operating with water at a high temperature, the front panel can prevent the apparatus having exposed surfaces at a high temperature whereby the risk of persons suffering burns when touching exposed portions of the apparatus can be avoided.

An intermediate member may be provided to space the front panel from the front plate, the intermediate member preferably being of corrugated section. Transfer of heat from the front plate to the intermediate member and

thus to the front panel can be limited by arranging for the intermediate member to make contact with the front plate only at a pluarlity of spaced apart positions, with the sum of the areas of the intermediate member in contact with the front plate being small compared with the overall area of the intermediate member.

Advantageously said areas are provided by local dimpling of the intermediate member. Thus, conduction of heat from the front plate to the intermediate members and thus to the front panel can only occur through the portions of the front plate and the intermediate member in contact at said small areas thereby limiting the maximum temperature which the front panel can attain.

Advantageously the front panel is formed integrally with end panels and a top cover for the apparatus, the top cover preferably being louvred to allow passage of air therethrough. The front panel, which is advantageously a plane smooth sheet, is preferably secured to the intermediate member by induction soldering together of contacting portions of the front panel and the corrugated intermediate member. The front panel and/or the intermediate member may, however, be louvred if desired.

The end panels and the top cover preferably have inturned flanges at their edges remote from their junction with the front panel, said inturned flanges being locally dimpled and secured to the rear plate of the radiator, such local dimpling heat transference from the rear plate to the end panels and top cover.

Alternatively the front panel may be louvred and provided of a zig-zag construction and be secured to the duct and to the front panel at spaced apart intervals therealong to space the front panel outwardly from the duct to limit heat transfer from the duct to the front panel.

A fan unit may be provided to cause or to assist flow of air through channels thereof. Preferably the fan is of an axial intake-tangential flow kind and is positioned at the upper end of the apparatus to draw air upwardly through the channels in the apparatus.

Advantageously the fan is formed by a plurality of fan units spaced axially along a common drive shaft, the fan units each being aligned with a respective channel of the apparatus and being driven by an electric motor preferably positioned at or adjacent a mid-position along the length of the drive shaft. A thermostat is preferably provided to control operation of the electric motor and thus of the fan unit. The thermostat may be set to cause operation of the fan upon fall below a determined temperature of air being drawn into the channels of the apparatus or alternatively upon rise above a determined temperature of air being drawn into the channels of the apparatus and thus the apparatus can be used as a heating means in cold weather or as air conditioning means in hot weather.

Preferably the fan is provided in a housing which can readily be engaged with or removed from the apparatus, as required preferably, though not necessarily, after removal of an apertured top cover of the apparatus.

The invention is diagrammatically illustrated by way of example in the accompanying drawings in which:—

Figure 1 is a plan view of an embodiment of convector space heating or cooling apparatus according to the invention with the left-hand side cut-away to show details of construction;

Figure 2 is a perspective view from the front, above and one end of a water duct, rear plate, front plate and intermediate member of the apparatus of Figure 1;

Figure 3 is a perspective view from above, the rear and one end of a front panel and integral end panels and top cover for the apparatus of Figure 1;

Figure 4 is a sectional view through the apparatus of Figure 1 formed by assembling together parts shown in Figures 2 and 3;

Figure 5 is a view similar to Figure 1 showing three alternative forms of duct;

Figures 6, 7 and 8 are views respectively similar to Figures 1, 2 and 4 of another embodiment of convector space heating and cooling apparatus according to the invention, Figure 7 showing the apparatus of Figure 6 without the front panel and Figure 8 being a sectional view taken on line VIII—VIII of Figure 6;

Figure 9 is a partly cut-away elevation of convector space heating or cooling apparatus according to the invention incorporating a fan unit;

Figure 10 is an end view of the apparatus of Figure 9; and

Figure 11 is a view similar to Figure 10 of a modification.

Referring to Figures 1 to 4, convector space heating or cooling apparatus 20, particularly suitable for operation with water at a high temperature, has a zig-zag duct 21 formed by spaced-apart corrugated walls 22 and 23. The wall 22 is shaped at its ends at 22a and 22b to form vertical headers 24 and 25 of greater cross-sectional area than the remainder of the duct 21. Water entering through an inlet pipe 26 will thus tend to flow upwardly through the header 24 to give a more even distribution of hot water within the duct 21 than would be the case if the header 24 was not of increased section. Cold portions at the upper corners of the radiator 20 are thereby avoided.

A rear plate 27 and a front plate 28 are secured respectively to the wall 22 and the

wall 23 of the duct 21, advantageously by welding. The plates 27 and 28 are louvred as shown at 29, the portions of the plates 27 and 28 forming the louvres being so pressed that they slope inwardly and upwardly to allow air to pass through the louvres in the direction indicated by the arrows 30 in Figure 4.

An intermediate member 31 is formed with corrugations 32 and at the crests of the corrugations the intermediate member 31 is provided with dimples 33 (Figure 4) at positions spaced-apart vertically one from another. The intermediate member 31 is secured to the front plate 28 by spot welding the crests of the dimples 33 to the front plate 28. The intermediate member 31 is thus only in physical contact with the front plate 28 at the crests of the dimples and heat transfer by conduction from the inner front plate 28 to the intermediate member 31 is limited to heat flow through the walls of the dimples 33.

A front panel 34 is formed as a plane member, lies against the intermediate member 31 and is secured thereto preferably by induction soldering or by an adhesive. At each of its ends the front panel 34 is formed integral with an end panel 35, each end panel 35 at its edge remote from its junction with the front panel 34 bearing an inturned flange 36 which is locally inwardly dimpled at positions 37. As shown in Figures 1 and 4 the dimples at the positions 37 lie against the rear face of the rear plate 27 when the front panel 34 is in position against the intermediate member 31 and the flanges 36 can be secured to the rear plate 27 by spot welding the crests of the dimples at the positions 37. At its top edge the front panel 34 is formed integral with a louvred top cover 38, the top cover 38 at its edge remote from that at which it is joined to the front panel 34 having a downturned flange 39 which is locally dimpled at positions 40 whereby it can be secured to the rear plate 27 by spot welding through the crests of the dimples 40.

In operation, with hot water passing through the inlet 26 into the duct 21, the walls of the duct 22 and 23 are heated by the water and, by conduction, transfer heat to the rear plate 27 and the front plate 28 to heat them to a similar temperature to the temperature to which the walls 22 and 23 are heated by the water. Due to convection air passes upwardly through spaces 41 between the wall 23 of the duct 21 and the front plate 28, some of such air passing inwardly through the louvres 29 in the front plate 28. Air also passes upwardly through spaces 42 between the wall 22 of the duct 21 and the rear plate 27, some of such air entering the space 42 through the louvres 29 in the rear plate 27. The air passing upwardly through the spaces 41 and 42 passes outwardly through the louvres in the top cover 38, the louvres in the top cover 38 being so directed that air passing therethrough is directed towards the respective adjacent end of the radiator 20. Some heat is conducted from the front plate 28 to the intermediate member 31 but the extent of such conduction is limited by the areas of the dimples 33 in contact with the front plate 28. Air will also pass upwardly through spaces 44 between the front plate 28 and the intermediate member 31 and through spaces 45 between the corrugations 32 of the intermediate member 31 and the front panel 34, the air passing through the spaces 44 and 45 assisting in cooling the intermediate member 31 and the front panel 34.

Figure 5 shows three embodiments of a duct to replace the duct 21 of Figures 1 to 4. Features of the embodiment shown in Figure 5 which are similar to those shown in Figures 1 to 4 have been marked with the same reference numerals and not further described.

A duct 51 shown at the lefthand side of Figure 5 has a rear wall 52 and a front wall 53 which are so formed that the duct 51 when viewed from above has, what may be called, an H-section, that is to say the walls 52 and 53 extend in parallel at portions 52*a*, 53*a* then diverge in opposite directions along portions 52*b*, 53*b*, extend in parallel again at portions 52*c*, 53*c*, but at a spacing much greater than the spacing between the portions 52*a* and 53*a*, before converging along portions 52*d*, 53*d* to extend again in parallel at portions 52*e*, 53*e*. At their ends the walls 52, 53 are shaped to form headers 54 of greater cross-sectional area than the remainder of the duct 51.

At the righthand side of Figure 5, a duct 61 is shown which is a modification of the duct 51, the modification comprising inclusion of intermediate portions 62*f* and 63*f* which increase the cross-section of the duct at places where the walls thereof diverge from and converge towards being in parallel and closely spaced. The portions 62*f* and 63*f* assist in directing water flow to the front and rear extremities of the duct.

The embodiment shown at the central portion of Figure 5 has a duct 71 similar to the duct 61 of the righthand portion of Figure 5 but including a baffle plate 71*g* extending the full height of the apparatus to assist in directing the water to the front and rear extremities of the duct.

Referring to Figures 6, 7 and 8, convector space heating or cooling aparatus 80 has a duct 81, similar in form to the duct 61 of Figure 5, with a louvred rear plate 82. A louvred front plate 83 replaces both the front plate 28 and the intermediate member 31 of the embodiment of Figures 1 to 4 and is

formed to a zig-zag configuration with alternately bent portions 84 and 85 of the front plate 83 separated by portions 86 and 87, the portions 86 extending parallel to the general longitudinal direction of the front plate 83 and being secured by soldering or welding to the duct 81 and the portions 87 lying against and being secured by soldering or welding to a front panel 88. The temperature gradient along the portions 84, 85, which portions include the louvres, limits heat transference and prevents the front panel 88 from being raised to a temperature near that of the duct 81. The front panel 88 preferably is integral with end panels and a louvred top panel 89, in like manner to the front panel 34 of the apparatus 20 (described above with reference to Figure 3) and is secured to the rear plate 82 by dimpled portions 90 on a flange 91 as shown at the top of Figure 8. Figure 8 also shows a bracket 92 for securing the apparatus 80 to a wall, the bracket 92 having an upwardly extending portion 93 to engage through an aperture 94 in the rear plate 82.

Referring to Figures 9, 10 and 11, convector space heating or cooling apparatus 100 of the kind shown in Figures 6, 7 and 8, includes a fan unit 101 comprising a rectangular section box housing 102, having an open bottom and a louvred front 103, in which an axially fed tangential flow fan rotor 104 is mounted. As shown in Figure 9, the fan rotor 104 is provided by several separate units mounted on a shaft 105 mounted in bearings 106 and driven by a centrally disposed electric motor 107, each of the units preferably being aligned with a respective channel of the apparatus 100.

The fan rotor 104 draws air upwardly through channels between the duct 81 and the front member 83 and between the duct 81 and the rear plate 82, some of such air being drawn in through the louvres in the rear plate 82 and the front plate 83, and also draws air upwardly through the channels between the front plate 83 and the front panel 88. Such air passes through the louvres in the top panel 89 and is drawn in axially by the fan rotor 104, as shown by the arrows in Figure 9, and discharged by the fan rotor 104 through the louvres in the front 103 of the fan housing 102.

A thermostat 108 in the fan housing 102 is coupled by a capillary tube to a thermostat phial 109 mounted at the bottom of the apparatus 100 and controls the fan motor 107. The fan unit 101*a* shown in Figure 11 is similar to the fan unit 101 of Figures 9 and 10 but differs in its fixing arrangement since the front panel 88*a* of the apparatus on which it is mounted does not include a top cover thereby decreasing the resistance to flow of air to the fan unit 101.

The apparatus 100 and fan units of Figures 9, 10 and 11 can each be used alternatively for air conditioning, that is to say cooling, by passing cooled water through the duct 81 thereof. Thus, in cold weather the thermostat 108 can be set to cause operation of the fan motor 107 when the temperature sensed by the thermostat phial 109 falls below a determined temperature and in hot weather the thermostat 108 can be set, or readily replaced by a suitable thermostat which can be set, to cause operation of the fan motor 107 when the temperature sensed by the thermostat phial 109 rises above a determined temperature.

The fan unit 101 can be engaged over the upper end of the apparatus and secured by screws 110 as shown in Figure 10 or engaged over the upper end of apparatus from which the louvred top panel has been removed and discarded as shown in Figure 11. The thermostat phial is advantageously mounted in a hook-shaped member 111 of plastics material which can readily be hooked into the lowermost louvre aperture in the rear plate 82 as as shown in Figure 11, to support the thermostat phial in a desired position.

The fan unit 101 can, with suitable modifications, alternatively be mounted at the lower end of the apparatus to blow up the channels in the apparatus, but mounting it at the top of the apparatus gives better flow paths for the air due to the louvres in the rear plate 82 and the front plate 83.

WHAT I CLAIM IS:—

1. A convector space heating or cooling apparatus comprising a pair of sheet members of heat conducting material secured together to form a duct through which a heating or cooling liquid can flow, at least a front one of the sheet members being so shaped as to give it a greater wall length than the length of the apparatus and to form, with a plate secured thereto, a plurality of channels, between said front one of the sheet members and the plate, for the passage of air, and a front panel so disposed and arranged with respect to said plate and the walls of the duct that in operation transfer of heat from the walls of the duct to the front panel is limited, whereby the front panel, when the apparatus is used for heating, can only attain a temperature significantly lower than the temperature of the walls of the duct.

2. Apparatus according to claim 1, in which both of the sheet members are so shaped and a respective plate is provided for each of the sheet members, that is to say the apparatus includes a front plate and a rear plate.

3. Apparatus according to claim 1 or 2, in which each of the shaped sheet members is formed to a zig-zag and the two sheet members extend in parallel to one another and spaced apart to form a zig-zag duct of flattened cross-section.

4. Apparatus according to claim 2, in which the shaped sheet members each lie generally

in a respective plane, with the two planes being apart one from the other and with portions of the shaped sheet members drawn out laterally from their respective planes, at intervals along the length of the apparatus, to form lateral extensions of the duct defined by the portions of the sheet members lying in said respective planes.

5. Apparatus according to any one of claims 1 to 4, in which the air channels are so formed that when the apparatus in installed, they are substantially vertical.

6. Apparatus according to claim 2 or any one of claims 3 to 5 when appendant to claim 2, in which the front plate and/or the rear plate is or are louvred to allow passage of air therethrough.

7. Apparatus according to claim 2 or any one of claims 3 to 6 when appendant to claim 2, including an intermediate member of corrugated section to space the front panel from the front plate.

8. Apparatus according to claim 7, in which transfer of heat from the front plate to the intermediate member and thus to the front panel is limited by arranging for the intermediate member to make contact with the front plates only at a plurality of spaced apart positions, with the sum of the areas of the intermediate member in contact with the front plate being small compared with the overall area of the intermediate member.

9. Apparatus according to claim 8, in which said spaced apart positions are provided by local dimpling of the intermediate member.

10. Apparatus according to any one of the preceding claims, in which the front panel is formed integrally with end panels and a top cover for the apparatus, the top cover being louvred to allow passage of air therethrough.

11. Apparatus according to any of claims 7 to 10, in which the front panel is a plane smooth sheet and is secured to the intermediate member by induction soldering or welding together of contacting portions of the front panel and the intermediate member.

12. Apparatus according to any one of claims 7 to 10, in which the front panel and/or the intermediate member is or are louvred.

13. Apparatus according to claim 10, in which the end panels and the top cover have inturned flanges at their edges remote from their junction with the front panel, said inturned flanges being locally dimpled and the flanges being secured to the rear plate by means of the dimples.

14. Apparatus according to claim 1, in which the front plate is of a zig-zag construction and is secured to the duct and to the front panel at spaced apart intervals therealong to space the front panel outwardly from the duct.

15. Apparatus according to claim 14, in which the front plate is louvred.

16. Apparatus according to any one of the preceding claims, including a fan to cause or to assist flow of air through the channels.

17. Apparatus according to claim 16, in which the fan is of an axial intake tangential flow kind and is positioned at the upper end of the apparatus to draw air upwardly through the channels.

18. Apparatus according to claim 16 or claim 17, in which the fan is formed by a plurality of fan units spaced axially along a common drive shaft, the fan units each being aligned with a respective channel of the apparatus and being driven by an electric motor positioned at or adjacent a mid-position along the length of the drive shaft.

19. Apparatus according to claim 18, including a thermostat to control operation of the electric motor and thus of the fan units.

20. Apparatus according to claim 19, in which the thermostat is set to cause operation of the fan upon fall below a determined temperature of air being drawn into the channels.

21. Apparatus according to claim 19, in which the thermostat is set to cause operation of the fan upon rise above a determined temperature of air being drawn into the channels.

22. Convector space heating or cooling apparatus substantially as hereinbefore described and illustrated with reference to any one of the accompanying drawings.

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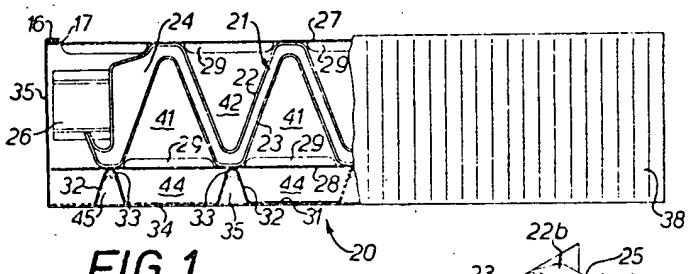

FIG. 1.

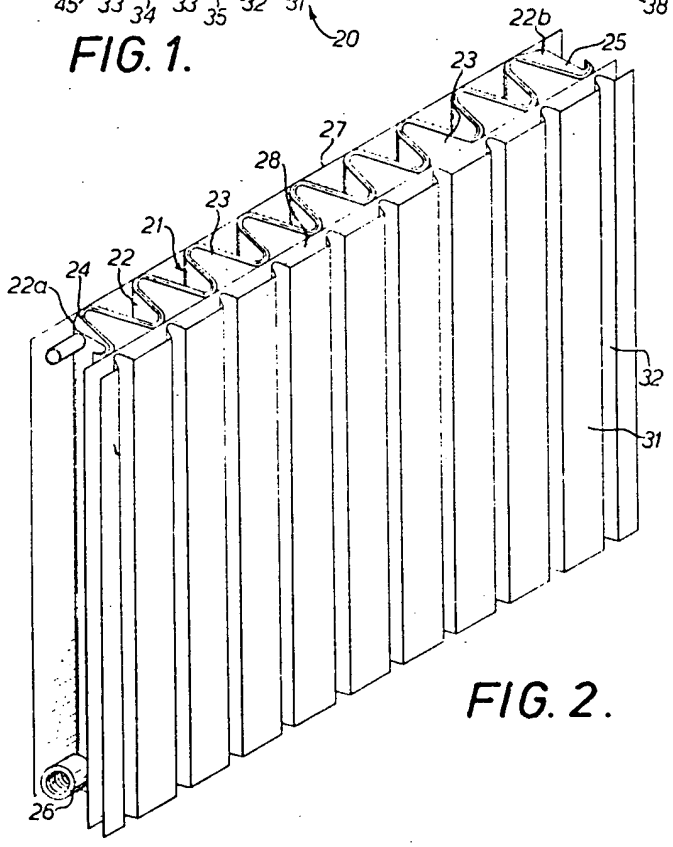

FIG. 2.

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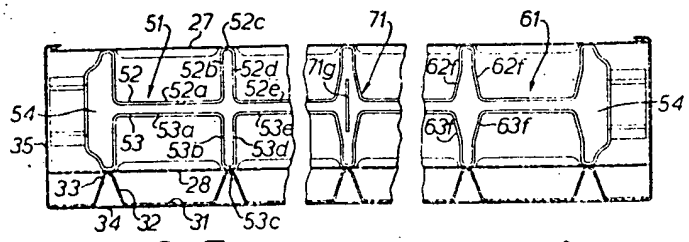

FIG. 5.

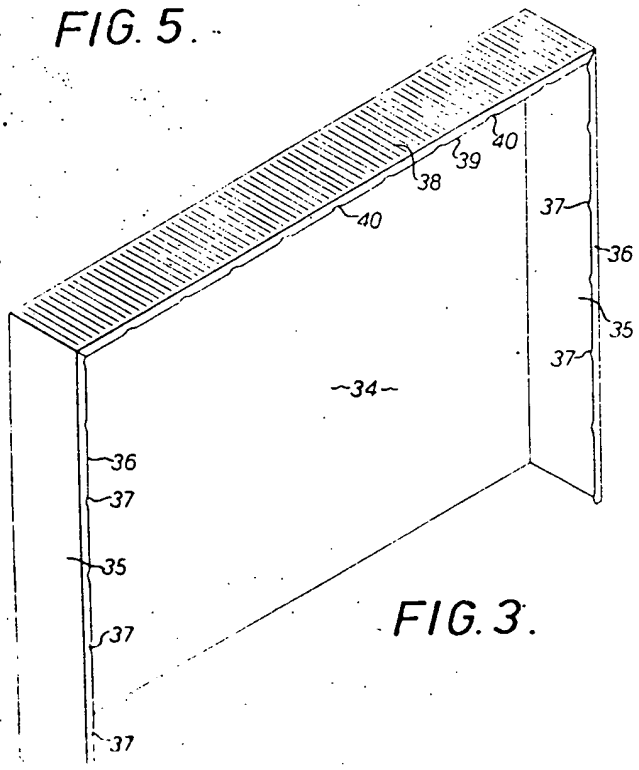

FIG. 3.

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FIG. 4.

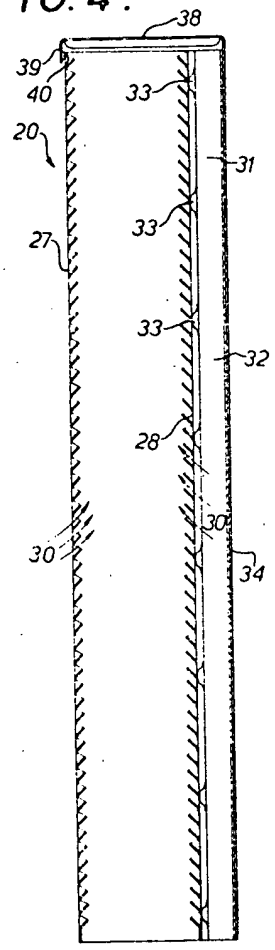
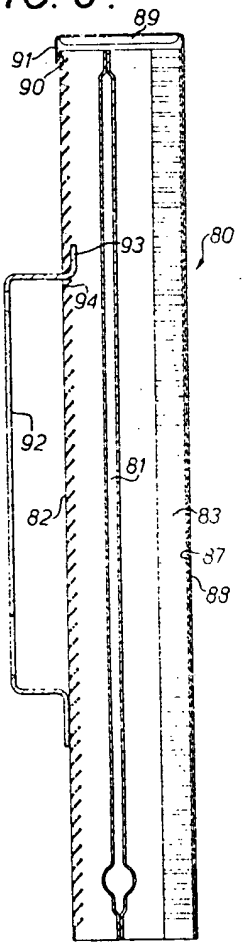


FIG. 8.



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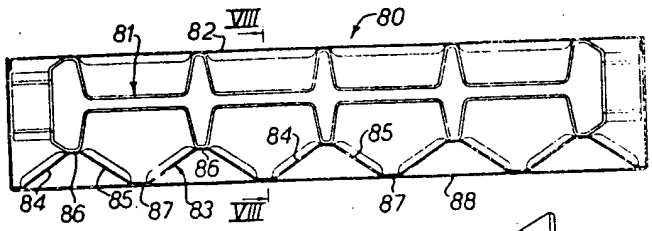

FIG. 6.

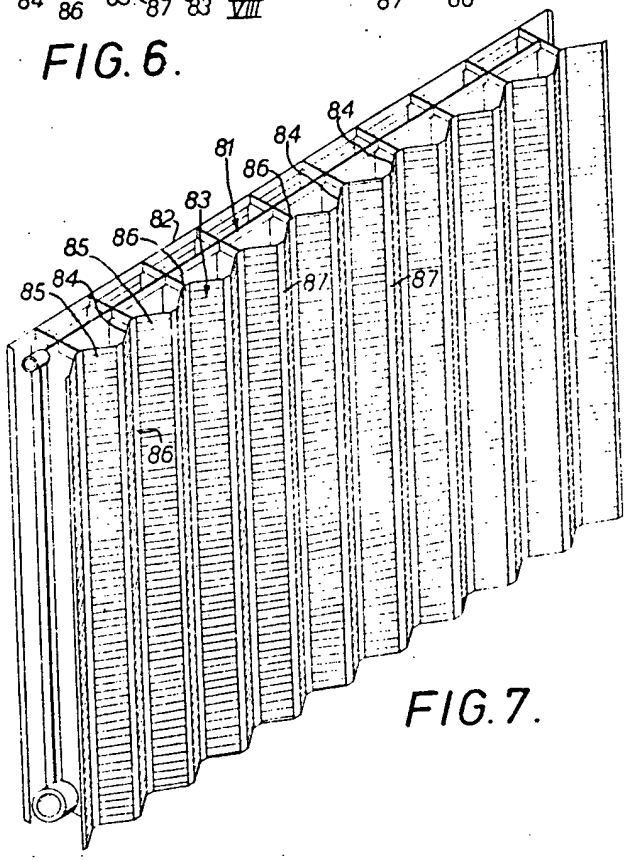

FIG. 7.

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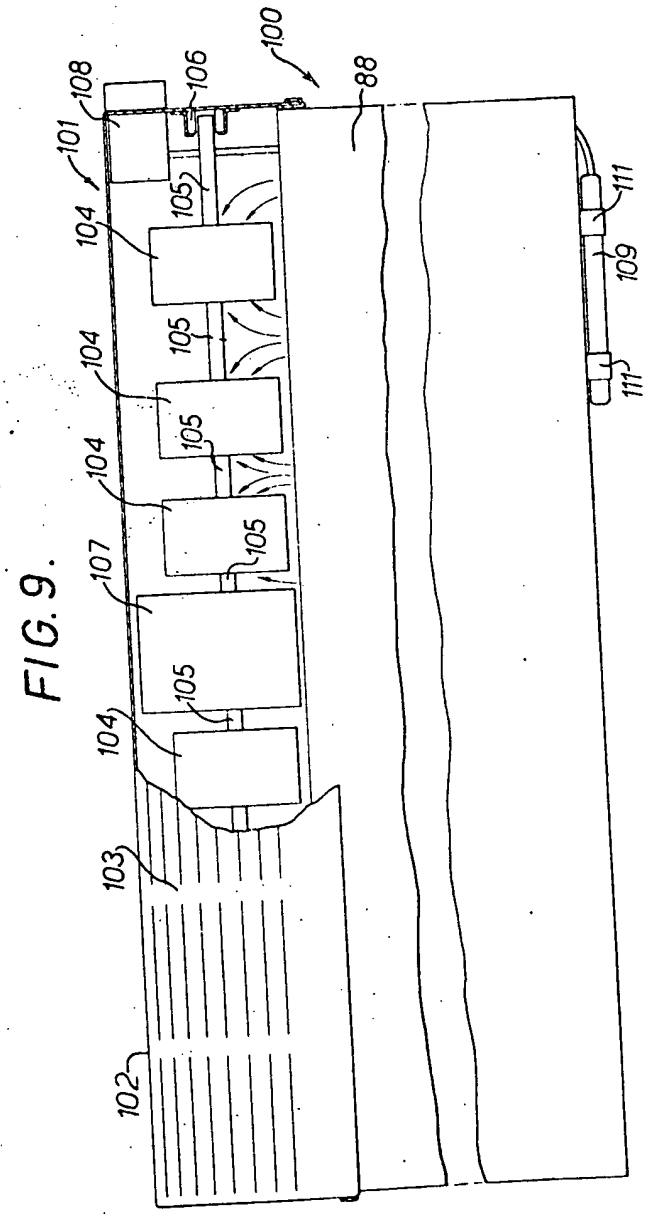

FIG. 9.

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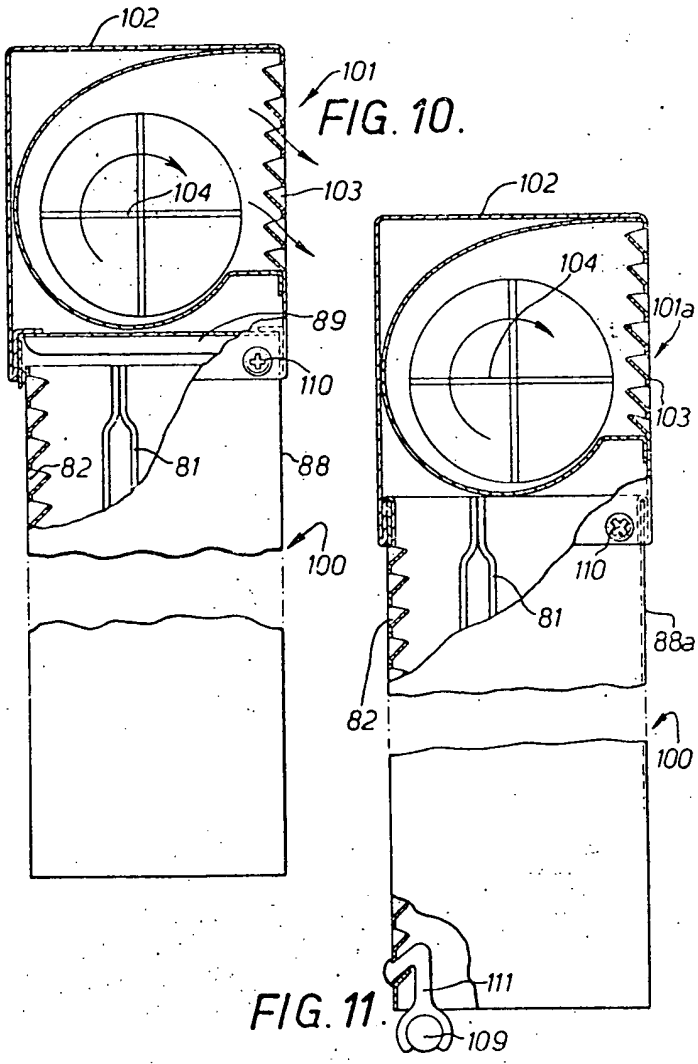

FIG. 10.

FIG. 11.